

Code	Session Title	Details	Date	Start Time	End Time
PCW01	PCW01 - Back to Basics	Back to Basics enables attendees to prepare themselves for the full MTC. Ideal for first time attendees and those new to the field of membrane technology, Back to Basics gives the audience exposure to membrane experts and knowledge in a focused forum. In addition, participants in the afternoon will be able to see a full-scale membrane plant in operation during a site visit, scheduled for the afternoon.	2/21/2022	8:00 AM	11:30 AM
PCW01-01	Intro to Workshop and Membrane Basics	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	8:00 AM	8:30 AM
PCW01-02	MF/UF Technology and Application Overview	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	8:30 AM	9:00 AM
PCW01-03	MF/UF Design Perspectives	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	9:00 AM	9:30 AM
PCW01-04	NF/RO Technology and Application Overview	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	9:30 AM	10:00 AM
PCW01-05	Break	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	10:00 AM	10:15 AM
PCW01-06	NF/RO Design Perspectives	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	10:15 AM	10:45 AM
PCW01-07	MBR Technology and Application and Design Considerations	Goes with above PCW01 - this is a subsession of PCW01	2/21/2022	10:45 AM	11:15:00
PCW02	PCW02 - Membrane Cleaning: Cleaning Strategies for High and Low Pressure Membranes	This workshop will provide an in-depth review of membrane system cleaning. Topics include cleaning strategies for low pressure (MF/UF) and high pressure (NF/RO) membranes, design of CIP systems for high- and low-pressure membranes and disposal of spent CIP solutions. Presentations will include case studies from full-scale installations and trouble shooting membrane fouling for improved cleaning regimes. This workshop will also include a hands-on training component (details to follow). Attendees will gain in-depth knowledge on membrane cleaning strategies from industry experts, including system owners.	2/21/2022	8:00 AM	11:30 AM
PCW02-01	Introduction	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	8:00 AM	8:05 AM
PCW02-02	CIP System Design, Including Waste Disposal	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	8:05 AM	8:35 AM
PCW02-03	MF/UF Cleaning Strategies	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	8:35 AM	9:15 AM
PCW02-04	RO/NF Cleaning Strategies	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	9:15 AM	10:00 AM
PCW02-05	Break	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	10:00 AM	10:15 AM
PCW02-06	Foulant Characterization and Autopsies	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	10:15 AM	10:45 AM
PCW02-07	Cleaning Experiences and Optimization at Orange County Water District, CA.	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	10:45 AM	11:25 AM
PCW02-08	Wrap-Up	Goes with above PCW02 - this is a subsession of PCW02	2/21/2022	11:25 AM	11:30 AM

PCW03	PCW03 - Potable Reuse: Membranes Role to Play	As water resources continue to be stretched, indirect and direct potable reuse is increasingly entering the picture to meet this critical need. This workshop focuses on the role membranes (MBR, UF and RO) will likely fill in the advanced treatment necessary to reliably achieve the quality for potable use, including attention to the development of real and practical integrity testing/confirmation for membranes used in these applications. This workshop provides the attendee with a detailed understanding of the variables which impact membrane use, along with an understanding of the applicability of membrane integrity testing/confirmation in various applications, and a future state visionary workshop on what the future of integrity testing could hold. This workshop is ideal for experienced membrane professionals looking at the near future of potable reuse systems.	2/21/2022	1:00 PM	4:30 PM
PCW03-01	Welcome and Introduction	subsession of above	2/21/2022	1:00 PM	1:05 PM
PCW03-02	Current State of Membranes for Potable Reuse (IPR/DPR)	subsession of above	2/21/2022	1:05 PM	1:35 PM
PCW03-03	RO Integrity Testing/Confirmation - How to Get Credit?	subsession of above	2/21/2022	1:35 PM	2:05 PM
PCW03-04	UF For Potable Reuse: What Does the Future Look Like?	subsession of above	2/21/2022	2:05 PM	2:35 PM
PCW03-05	Break	subsession of above	2/21/2022	2:35 PM	2:50 PM
PCW03-06	MBR for Potable Reuse: What Does the Future Look Like?	subsession of above	2/21/2022	2:50 PM	3:25 PM
PCW03-07	Advanced Water Treatment Impact on Operations	subsession of above	2/21/2022	3:25 PM	3:55 PM
PCW03-08	Panel Discussion	subsession of above	2/21/2022	3:55 PM	4:30 PM
PCW04	PCW04 - Operation of Advanced Water Treatment Systems	Outline the skills and knowledge that operators of advanced water treatment systems are required to have. Describe the reasons for implementing advanced water treatment systems. Describe the treatment processes that are associated with advanced water treatment. Describe the critical control points associated with advanced water treatment systems	2/21/2022	1:00 PM	4:30 PM
PST01	PST01 - Tuesday Poster Session		2/22/2022	5:15 PM	6:30 PM

PST01-02	Membrane Treatability Study for a Reclaimed Water Supply	The City of Sarasota, Florida provides reclaimed water to Bradenton River Utilities, who intends to install Aquifer Storage and Recovery (ASR) wells. Parameters with concentrations in the City's final reclaimed water found to exceed limits for ASR include sodium, total trihalomethanes, haloacetic acids, total dissolved solids (TDS), total organic carbon (TOC), and total organic halogens (TOX). This poster presentation focuses on the ultrafiltration and reverse osmosis bench-scale studies conducted by the University of Central Florida for the City. The primary goals of the bench-scale studies are to reduce TOC, TOX, TDS, microbes, and explore perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and 1,4-dioxane removal.	2/22/2022	5:15 PM	6:30 PM
PST01-03	Retrofit of Hollow Fiber MBR with Submerged Ceramic Membranes for Fats, Oils and Hydrocarbon Management in Industrial Reuse Plant	An industrial MBR experienced membrane fouling from fats, oils and greases with concentrations > 100 mg/l. The system experienced cumbersome cleaning and significant downtimes. After some investigations, it was decided that submerged ceramic membranes using silicon carbide construction, would be employed to replace the PVDF hollow fibers in the MBR, and that the goal was to reuse as much of the existing MBR plant as possible. After a 2 month long pilot trial, a design was developed for an average net flux of 8.4 GFD and peak net flux of 14.5 GFD, with a cleaning frequency of over 30 days and 7 days respectively. Results from the pilot trial, the retrofit design, and operating experiences from the commercial plant will be discussed.	2/22/2022	5:15 PM	6:30 PM
PST01-04	Impact of Hydraulic Retention Time (HRT) on Particle Properties During Coagulation: Implications for Low Pressure Membrane Studies	Coagulation without flocculation may be applied prior to direct low pressure membrane filtration to reduce fouling. When conducting continuous-flow coagulation-membrane trials at bench-scale, it is often challenging to provide short hydraulic retention times (HRTs) which are representative of full-scale as these typically require relatively high flowrates and quantities of water. The present study examines the impact of employing long HRTs that have been reported in previous coagulation-membrane studies. Results indicate that long (20 min) versus short (2 min) HRTs may exaggerate positive effects on particle size and structure which supports the use of full-scale HRTs during bench-scale continuous-flow coagulation-membrane studies.	2/22/2022	5:15 PM	6:30 PM
PST01-07	Selection of Analytical Methods and Sampling Techniques for Membrane Treatment of PFAS in Water	This presentation will outline the most suitable analytical methods and sampling/handling techniques for analyzing PFAS membrane treatment permeate, feed, and concentrate samples.	2/22/2022	5:15 PM	6:30 PM

PST01-08	Membrane Nitrate Selectivity and the Impact to Advanced Treatment Design: An MBR-RO-AOP Reuse Case Study	<p>Nitrogen-based compounds are becoming design bottlenecks for many wastewater treatment facilities with tight total nitrogen (TN) limits. RO membrane desalination is very useful as a broad-spectrum TN removal process; however, commercial polyamide membranes are exhibiting marginal rejection of many of these compounds within harsh wastewater environments, especially nitrate and nitrite, and require unique accommodations in design to maintain affordability without sacrificing effluent quality. This presentation will discuss how RO membrane nitrate selectivity was modeled, projected, and factored into the design of a 12.5 MGD reuse facility for the City of Phoenix treating tertiary MBR filtrate to meet an effluent TN limit of 10 mg/L as N.</p>	2/22/2022	5:15 PM	6:30 PM
PST01-10	Procurement Approaches to Beat the Clock	<p>The Carlsbad Ocean Desalination Plant requires a new raw water supply once the co-located power plant is decommissioned. To meet tight time constraints and design risk aversion tactics, the owner elected to procure a new intake pump station through a fixed price design build contract. The schedule became so compressed that long lead items could not be delivered in time if they weren't purchased during preliminary design and prior to a Design Builder selection. This presentation will focus on the challenges, procurement and delivery of the project with specific emphasis on procuring nearly \$5M worth of owner furnished pumps.</p>	2/22/2022	5:15 PM	6:30 PM
PST01-11	On the Interfacial Properties Governing Membrane-Biofouling: The Disproportionate Contribution of Electron Donor Interactions	<p>In this study, we explored the role of van der Waals, electron-donor (δ^-) and electron-acceptor (δ^+) surface tension components for different polymeric membrane materials on bacteria cell and biopolymer adhesion in a laboratory-scale membrane bio-reactor (MBR). The model and experimental results suggest the δ^- functionality of a membrane is the principal indicator for the biofouling propensity of a membrane, and hence, should be the focus of efforts to improve membrane fouling-resistance through the selection of membrane polymers or surface modifying materials that exhibit monopolar δ^- functionality.</p>	2/22/2022	5:15 PM	6:30 PM

PST01-12	Plant Optimization and Lessons Learned from a UF and RO Water Treatment Plant	The City of Fargo (ND) owns and operates a 15 MGD UF and RO membrane water treatment plant to treat challenging surface water: 8-16 mg/L TOC, 300-700 mg/L total hardness, and 50 degrees (F) temperature seasonal swing. The plant was built with some unique features to monitor the treatment process performance and provide a high level of operation flexibilities. In the first two years operation, the plant encountered various challenges and these features help maintain smooth production. This presentation will share experiences and lessons Learned during the first two years operation, such as RO fouling analysis with varying flux and recovery, chemical design to mitigate biofouling, and selection/installation of mag flow meter on RO skids.	2/22/2022	5:15 PM	6:30 PM
PST02	PST02 - Wednesday Poster Session		2/23/2022	5:00 PM	6:00 PM
PST02-01	END® High Recovery Electrochemical Desalination	We will discuss how END® technology has reduced water usage and solved brine management issues for our customers in the industrial beverage industry, as well as for municipal water treatment and reuse. Each of these customers highlights the flexibility of END® technology to be retrofit alongside existing water treatment equipment. From reverse osmosis brine recovery to desalination of membrane bioreactor effluent, MI Systems specializes in designing water treatment systems to meet our customers' needs to reduce water consumption while augmenting their existing capabilities. Each of these cases also demonstrate our ability to deliver greater than 95% water recovery over a variety of water sources.	2/23/2022	5:00 PM	6:00 PM
PST02-02	Influence of Zwitterion Molecular Structures on Mixed Matrix Membrane Fouling Resistance for Oily Wastewater	Intensive water input requirement and extensive wastewater production are two major issues associated with oil sands mining. Membrane technologies are considered as the feasible solution to treat and reuse of oil sands produced wastewater (OSPW). Zwitterion-based mixed matrix membranes (MMMs) with designing characteristics of enhanced water flux, selectivity, and fouling mitigation are a promising class of advanced membranes for OSPW treatment. Because of its super hydrophilic property in the presence of abundant charged moieties, strong hydration layer and excellent fouling resistance, zwitterions (ZWs) have gained increasing attention in membrane research.	2/23/2022	5:00 PM	6:00 PM

PST02-03	The Impact of Ultrafiltration Membranes on Microplastics in Drinking Water Plants	<p>Microplastics are a contaminant of emerging concern. They are all around us, in the air we breath and the water we swim and bath in. As the health impacts on ingesting microplastics become better understood, and the ability to confidently measure microplastics improve, we are better able to quantify the microplastics in our water supply and the effectiveness of various technologies to remove them. Ultrafiltration membranes might be expected to remove microplastics due to the small pore size (0.02 micron), but their polymeric construction raises concerns that the membrane itself may shed microplastics. This study will show the overall ability of UF to remove (and potential contribution of) microplastics in Ontario drinking water plants.</p>	2/23/2022	5:00 PM	6:00 PM
PST02-05	Response Surface Modeling for Reverse Osmosis Remediation of Wastewater Containing Energetic Compounds	<p>This poster will present the results of a response surface model used to evaluate reverse osmosis membranes for treatment of industrial wastewater containing energetic compounds. These energetic compounds are munitions common in the wastewater of army ammunition plants, such as NTO, DNAN, NQ, and RDX. The response surface model consists of three factors - pH, pressure, and ion concentration - and was tested for two RO membranes. Additional tests outside the response surface approach include an ultrafiltration membrane and a nanofiltration membrane. The poster will include the response surfaces, membrane fouling evaluation, and rejection characteristics of the ultrafiltration and nanofiltration membranes.</p>	2/23/2022	5:00 PM	6:00 PM
PST02-06	Urea recovery and fouling mitigation of fresh human urine using cross-flow reverse osmosis and nanofiltration	<p>Urea is a high-value chemical that is energy-intensive to produce. However, urea can be recovered from human urine by utilizing urea's low rejection from reverse osmosis (RO) and nanofiltration (NF) membranes, as compared to high rejection of other urine constituents. Previous studies have characterized urea permeation and fouling mitigation of fresh human urine using RO and NF in a dead-end orientation. However, limited research exists on the use of these membranes for this purpose in a cross-flow orientation. Thus, this presentation will detail research on urea permeation and fouling mitigation of fresh human urine using RO and NF, evaluating different pH pretreatment and microfiltration pretreatment.</p>	2/23/2022	5:00 PM	6:00 PM

PST02-08	Freshwater Recovery from Brackish Groundwater RO Concentrate via Photobiological Treatment and Secondary RO – A Laboratory Study	<p>Persistent and increasingly frequent severe droughts have led to the demand for utilization of nontraditional water resources such as brackish groundwater. The moderate TDS of brackish groundwaters allows for high recovery of fresh water via reverse osmosis (RO)-based desalination, but there is still considerable production of reverse osmosis concentrate. More fresh water can be recovered with the implementation of brackish diatom based photobiological treatment of RO concentrate and subsequent secondary RO. This presentation covers the bench scale four-liter semi-batch reactor treatment of RO concentrate from a full-scale brackish groundwater desalination facility and the preliminary investigations into secondary RO.</p>	2/23/2022	5:00 PM	6:00 PM
PST02-09	Alternative Approaches for Chemical and Pathogen Control in CA DPR Projects	<p>The draft California direct potable reuse (DPR) regulations require ozone and biologically activated carbon (BAC) prior to reverse osmosis (RO) and advanced oxidation process (AOP) for chemical control. Main interest with the proposed Ozone/BAC is to further remove chemicals that are poorly or moderately removed by the conventional RO membranes. Incorporating ozone and BAC into full advanced treatment may further increase operational complexity, footprint and costs which may direct interest of agencies toward IPR rather than DPR. This paper discusses alternatives to satisfy both chemical and pathogen control requirements of DPR and provides a great value for potable reuse community including researchers, regulators and public agencies.</p>	2/23/2022	5:00 PM	6:00 PM
PST02-10	PFAS Removal for Potable Reuse – New Hurdles to Pass Through	<p>The potable reuse industry has been proactive in addressing a large range of constituents of emerging concern through extensive monitoring and advanced treatment systems designed to address not only regulated parameters but many others as well. Today we are facing new hurdles with projects designed to remove not just CEC or PFAS, but many other future contaminants yet to be discovered as well. RO can be coupled with UV AOP treatment that is highly effective at removing many unregulated compounds such as PFAS, 1,4-dioxane, and other chemical pollutants that may be found at trace levels in RO permeate. These processes are being considered to overcome new hurdles faced by municipalities when considering wastewater effluent as a water source.</p>	2/23/2022	5:00 PM	6:00 PM

T1	T1 - The Southwest Water Reclamation Facility (SWRF)	<p>Tours are an additional cost and require pre-registration.</p> <p>Tour is limited to 18 attendees.</p> <p>The Southwest Water Reclamation Facility (SWRF) is the City of Henderson's first satellite wastewater treatment facility, beginning operations in 2012, it enables the City to support the community's increasing wastewater treatment and reclaimed water distribution demands. The SWRF has the capacity to treat up to 8 million gallons per day (mgd). The SWRF treatment stages consist of a headworks to remove organics and solids, followed by an activated sludge process. A state-of-the-art membrane bioreactor provides separation and disinfection, producing a highly treated effluent. Treated water is chlorinated and distributed to reclaimed customers in the southwest part of the City.</p>	7/21/2022	9:00 AM	11:30 AM
T2	T2 - The Southwest Water Reclamation Facility (SWRF)	<p>Tours are an additional cost and require pre-registration.</p> <p>Tour is limited to 18 attendees.</p> <p>The Southwest Water Reclamation Facility (SWRF) is the City of Henderson's first satellite wastewater treatment facility, beginning operations in 2012, it enables the City to support the community's increasing wastewater treatment and reclaimed water distribution demands. The SWRF has the capacity to treat up to 8 million gallons per day (mgd). The SWRF treatment stages consist of a headworks to remove organics and solids, followed by an activated sludge process. A state-of-the-art membrane bioreactor provides separation and disinfection, producing a highly treated effluent. Treated water is chlorinated and distributed to reclaimed customers in the southwest part of the City.</p>	2/21/2022	11:45 AM	2:15 PM
THU01	THU01 - NF and RO O&M		2/24/2022	8:15 AM	9:45 AM
THU01-01	Strategies for Mitigating Risk During Start Up and Commissioning of New and Retrofitted Reverse Osmosis Facilities	Reverse osmosis facilities often have significant controls logic and instrumentation that need to function properly to protect the membrane process from potential disruption or expensive damage. This presentation discusses strategies that can be used to facilitate a successful start up and commissioning phase to minimize risk and protects the membrane process. Two case studies will be presented showing how such strategies were implemented: the first at a new facility in Scottsdale, Arizona and the second on a facility expansion and retrofit in Goodyear, Arizona.	2/24/2022	8:15 AM	8:45 AM

THU01-02	Benefits of Operating with the New Thin-Membrane Technology in a Municipal Drinking Water RO	Mount Pleasant Water District is the first municipal drinking water RO system to benefit from new, Thin-Membrane Technology. The new technology increases the amount of active membrane area that can be manufactured in the standard spiral wound element. The result has been lower feed pressure, lower differential pressure and lower operating coast with no changes to system design or operation.	2/24/2022	8:45 AM	9:15 AM
THU01-03	Repair and Rehabilitation of Twenty Year Old NF Plant-Trial and Tribulation	The presentation will provide summary of repair and rehabilitation of existing 8-mgd nanofiltration plant that has operated over twenty years without any major upgrades or maintenance services. The key item to be discussed is the methods used to keep the NF plant operating while completing the construction work during the Covid outbreak and drought conditions in southern California.	2/24/2022	9:15 AM	9:45 AM
THU02	THU02 - Fouling and Scaling Management		2/24/2022	8:15 AM	9:45 AM
THU02-01	The Influence of Complex Ions in High Recovery and Brine Concentrator Saturation Calculations	As RO systems are pushed to increasingly higher recoveries, the concentration of salts in solution increases exponentially which demand more complex scaling calculations for proper system operation. One major factor in high salinity RO concentrates is the influence of complex ions on ionic equilibria which play a major role in long-range electrostatic interactions between ions. This paper will present a chemical model that uses complex ion pairing to project scaling chemistry at very high recoveries. This model was tested and validated during a pilot study by the City of Buckeye, AZ, where RO systems were run at over 90% recovery on both a conventional three-stage array and a closed-circuit array treating brackish well water.	2/24/2022	8:15 AM	8:45 AM
THU02-02	20+ Years of Drinking Water Related Coagulation/Flocculation-Low Pressure Membrane Studies: A Review of Impacts on Fouling	This review summarizes studies regarding coagulation/flocculation-low pressure membrane filtration that have been conducted since the 1990s, highlighting trends as well as key knowledge gaps based on published data. Coagulation/flocculation was grouped into three "configuration types" and further characterized in terms of coagulant dosage, retention time, and mixing intensity. The impact of configuration type on floc properties and membrane performance are discussed in detail, providing insight for the design and operation of pretreatment for low pressure membrane filtration. Understanding the impact of coagulation/flocculation on floc properties also helps reveal fouling mechanisms that dictate membrane performance.	2/24/2022	8:45 AM	9:15 AM

THU02-03	An Approach to Membrane Filtration Cleaning Explored Through 3 Case Studies	Paper provides information for owners and operators on how to manage cleaning. Most facilities are set up on a universal cleaning recipe variation which is chlorine and acid for the cleans. This presentation is intended to help the operator understand how to modify this starting point recipe appropriately for their water quality and membranes.	2/24/2022	9:15 AM	9:45 AM
THU03	THU03 - MBR - Part 1		2/24/2022	8:15 AM	9:45 AM
THU03-01	Pioneering Demonstration of Pathogen Log Reduction Values Via Turbidity Monitoring in a Full Scale Membrane Bioreactor	The WaterVal Membrane Bioreactor (MBR) validation protocol proposed a method to link permeate turbidity monitoring to the pathogen Log Reduction Value (LRV). A full scale MBR was evaluated in-line with the approach outlined in WaterVal. The results demonstrated that the MBR LRVs were relatively high, even with permeate turbidities exceeding 0.5 NTU. The results of this study are being evaluated as part of the Water Research Foundation (WRF) Project 4959, which aims to update guidance on real time validation of MBRs for potable reuse. This presentation will describe how to calibrate turbidity with MBR LRVs, contrast results against WaterVal and perspectives from WRF 4959, and highlight key outcomes from this first full scale demonstration.	2/24/2022	8:15 AM	8:45 AM
THU03-02	Sturgis: More than a Motorcycle Rally	Following planning, financing, and design, the Sturgis Membrane Bioreactor (MBR) Water Resource Recovery Facility (WRRF) is currently under construction with construction manager at risk (CMAR) delivery method, with completion in fall 2021. Nutrient discharges are not yet restricted in South Dakota, although receiving water is designated as a cold water fishery with 10mg/L BOD and TSS limits, and a less than 2 mg/L ammonia limit. The configuration is simplified to utilize chemical phosphorus removal as it is deemed appropriate for the size facility and reduced operational complexity. Anoxic zones were included for future total nitrogen limits and flexibility to control alkalinity through denitrification alkalinity restoration.	2/24/2022	8:45 AM	9:15 AM
THU03-03	Reviewing the Options: Treatment Alternatives Evaluation for Tempe's Kyrene WRF	A comprehensive evaluation of a wide range of existing and cutting-edge treatment processes was conducted for the City of Tempe's Kyrene Water Reclamation Facility (KWRF), as part of a larger program to re-start the plant. The most suitable treatment technologies and approach for plant improvements were determined as part of recommissioning the KWRF. This included the previous membrane bioreactor (MBR) process and other possible processes based on current developments in wastewater treatment and reclamation. MBR was shown to be the most appropriate process since it had the best finished water quality, lowest capital cost from utilizing the existing facilities and the intensified process offers the greatest potential capacity.	2/24/2022	9:15 AM	9:45 AM
THU04	THU04 - Ceramics		2/24/2022	8:15 AM	9:45 AM

THU04-01	DBP Compliance via Ultra-Coagulation, Ceramic Membranes & Free Chlorine	Novel "Ultra-coagulation" process, combined with continuous ceramic ultrafiltration, has demonstrated significantly greater DOC and THM/HAA precursor removal versus traditional coagulation/filtration processes and allows communities that presently rely on difficult-to-manage chloramines to achieve DBP compliance to convert to easily managed free chlorine throughout their system and thus, eliminates operational challenges of chloramines. Several case studies employing this novel process will be reviewed & include performance and cost data.	2/24/2022	8:15 AM	8:45 AM
THU04-02	Don't Let Chemical Cleaning Dictate Membrane Life	Paper discusses long term impacts chemical cleaning has on ultrafiltration and microfiltration membranes. From impacting permeability recovery as well as membrane integrity, prolonged chemical cleaning greatly impacts membrane life and ultimately, system economics. Silicon carbide membranes offer new capabilities with regards to chemical cleaning due to the chemical inertness of the material itself. The abstract includes case studies/data showing both the positive and negative impact chemical cleaning can have on all membranes.	2/24/2022	8:45 AM	9:15 AM
THU04-03	Advancements in Ceramic Membranes – They are Not All the Same	Significant advancements in ceramic membranes has been developed over the last 30 years. The presentation will be a comprehensive discussion about the development of ceramic membranes and current status of its development. Many misunderstandings about this technology exist and this paper will clarify its state of the art.	2/24/2022	9:15 AM	9:45 AM
THU05	THU05 - NF/RO - Part 2		2/24/2022	10:30 AM	12:00 PM
THU05-01	Real-Time Data Collection, Analytics, and Visualization for Operating and Maintenance of RO Membranes at Chino II, CA	Optimizing the operations and maintenance of RO systems can prevent costly repairs and unscheduled downtime for maintenance. This presentation describes challenges faced and strategies employed in designing a RO system decision support framework, recently deployed in Chino Desalter Authority California, providing operators with the intelligence to proactively maintain RO membranes and reduce costs.	2/24/2022	10:30 AM	11:00 AM
THU05-02	Occurrence of Nanometer and Micrometer Particles in Membrane Feed-Concentrate Channels	An investigation into the occurrence of nanometer and micrometer range particles in the feed-concentrate channels of an operating, production-capacity nanofiltration (NF) membrane process was conducted. Samples of the feed, permeate and concentrate bulk streams were sampled and submitted for particle analysis. Particle distributions using nanoparticle tracking and single particle optical sensing technologies were employed to evaluate the size (average diameter) and concentration of particulates in NF process feed-concentrate channels. Results of the investigation will be presented.	2/24/2022	11:00 AM	11:30 AM

THU05-03	NF/RO Membranes Ability to Remove 1,4-Dioxane From Water Sources Used for Drinking Water Production	One of the most important current challenge for drinking water company is to be able to treat new emerging contaminants. In this study, lab-scale trials were conducted to assess the ability of five NF/RO membranes to remove 1,4-dioxane. Rejection from 74% to 98% were obtained with spiked synthetic water and contaminated groundwater under standard operational conditions. Additional tests also indicated that pressure could improve the rejection of loose membranes whereas for tight membranes, the rejection is directly induced by their intrinsic properties.	2/24/2022	11:30 AM	12:00 PM
THU06	THU06 - Seawater RO		2/24/2022	10:30 AM	12:00 PM
THU06-01	Lessons Learned from the Start-Up and Commissioning of a Seawater Desalination Plant in a Palestinian Territory	In a Palestinian territory, fresh water sources have deteriorated beyond suitability for human consumption so much that seawater desalination became the necessary solution to meet the potable water demand. In 2018, a modular pre-assembled RO system was installed with a capacity of 0.94 MGD. The 24-month project was not without challenges in procurement and logistics. Some of the lessons learned will be shared as well as potential considerations for installations in similar regions.	2/24/2022	10:30 AM	11:00 AM
THU06-02	Membrane Management Insights at a Large Scale SWRO Desalination Plant	The operation of mega size desalination facilities is complex and dynamic. The RO membranes are the highest value component of an SWRO system, and it is of paramount importance to ensure that their performance is maintained throughout operation to ensure long-term plant availability and efficiency, and minimize downtime. This paper illustrates the Membrane Management program of the 53,000 RO membranes installed at the Hadera Desalination Plant, in Israel. The presentation will focus on the analysis of membrane performance along 11 years of operation and the maintenance protocol that allows maintenance of membranes in order to increase the value of the assets along the operation lifecycle.	2/24/2022	11:00 AM	11:30 AM
THU06-03	122,000 M3/Day into a 106,700 M3/Day Footprint - Seawater Desalination Expansion in Morocco	Jacobs led a team including OCP and Worley/JESA in a technical evaluation of the existing plant and the subsequent production of design documents to increase the capacity of the facility to 122,000 m3/day. This "Phase II+" expansion fits within the existing footprint, designed for only 106,700 m3/day. This paper/presentation will discuss the technical evaluation and the details of the plant expansion.	2/24/2022	11:30 AM	12:00 PM
THU07	THU07 - MBR - Part 2		2/24/2022	10:30 AM	12:00 PM

THU07-01	Using MBR for On Site Water Recovery in New Mexico – Challenges and Solutions	<p>The Albuquerque Bernalillo County Water Utility Authority (Water Authority) are developing a state of the art on site water resources recovery plant, located at a shopping center in the uptown district of Albuquerque.</p> <p>This presentation will review some of the challenges and solutions in the journey of adapting MBR into this satellite facility ranging from siting the facility in a sensitive area, harvesting of wastewater, a review of sustainability, matching system sizing to demands and operational considerations.</p>	2/24/2022	10:30 AM	11:00 AM
THU07-02	Maximizing Flexibility with MBR to Reduce the Long-term Cost to Operate	<p>The Wickenburg Ranch Water Reclamation Facility (WRWRF) is a 265,000-gpd facility with a peak flow capacity of 795,000-gpd, with a planned buildout capacity of 1.4 MGD, which utilizes membrane bioreactor (MBR) technology. The recently completed Phase 2 expansion was completed with no physical changes to the footprint of the reactor, and only minimal mechanical additions, and returned a capital savings of over \$4M for the expansion and reduced the construction duration of Phase 2 by over 6-months.</p> <p>This presentation will provide real-world examples for designers, constructors, owners, and operators to consider when planning and delivering similar facilities, and how to maximize the ease of operation, minimize the effort to sustain the quality</p>	2/24/2022	11:00 AM	11:30 AM
THU07-03	Hitting a Moving Target - Designing an MBR System With Uncertain Nutrient Limits	<p>The Fort Mill Water Pollution Control Plant (WPCP) is currently permitted to treat a capacity of 3.0 mgd. Due to the proximity of the service area to the City of Charlotte, annual average flows are projected to almost triple by the year 2024. As a result, the Town of Fort Mill initiated a master planning effort to evaluate the existing plant and determine the upgrades necessary to increase capacity and plan for future nutrient limits in both the near- and long- term. This presentation will discuss the findings of these evaluations and how the Town incorporated the inherent uncertainty in flow projections and changing effluent requirements to prepare a flexible plan for near- and long-term upgrades.</p>	2/24/2022	11:30 AM	12:00 PM
THU08	THU08 - Industrial Applications - Part 1		2/24/2022	10:30 AM	12:00 PM
THU08-01	Lessons Learned in the Construction of an 18.3 MGD Sulphate Removal Process (SRP) System for Oil Field Production	<p>In 2017, SafBon Water Technology was awarded one of the largest Sulphate Removal Process (SRP) projects to supply an 18.3 MGD (69,300 m3/d) Nanofiltration (NF) system located in Saudi Arabia. One of the few land based Sulphate Removal Facilities (SRF) in the world, the construction of the system has taken over 2 years and has recently been commissioned. This presentation will describe the overall process, challenges, successes and lessons learned throughout the project.</p>	2/24/2022	10:30 AM	11:00 AM

THU08-02	Real Time Scaling Ion Measurement and Selective Removal for RO Performance Maximization	The authors will disclose how real time scaling ion sensors are used to boost reverse osmosis (RO) recovery on variable chemistry feed flows while protecting membrane health. The presentation will also review how to remove scaling ions in an RO-friendly manner, through use of the same sensors.	2/24/2022	11:00 AM	11:30 AM
THU08-03	The Value and Challenges of Chlorination/Dechlorination Process Optimization in Power Generation	Quality of the steam cycle water requires special attention and chlorination/dechlorination phase is very important, especially for reclaimed water sources. Ability to accurately measure and control chlorine concentrations allows to minimize membrane maintenance and extend life of the RO filters. Improved management of dechlorination, permitted by efficient ULR chlorine monitoring, resulted in over 30% reduction in SBS usage and halved the frequency of CIP at a power utility. This process optimization is also projected to reduce losses in power production, providing further cost savings.	2/24/2022	11:30 AM	12:00 PM
THU09	THU09 - NF/RO - Part 3		2/24/2022	1:30 PM	3:00 PM
THU09-01	Longer Term Impact of Desalinated Water on Blended Supplies	The burgeoning development alternative water resources, including seawater, brackish groundwater, saline surface water, stormwater, and recycled wastewater, is increasing the use of reverse osmosis treatment. Although the need for strategic integration of desalinated water into existing supplies is well-known, literature on the influence of variable blend water composition and longer term impact on water quality is limited. Water Research Foundation (WRF) Project 5061 addresses both of these issues in a study encompassing the first four years of operation of the Carlsbad Desalination Plant. This presentation will discuss the findings of WRF 5061 generated to date.	2/24/2022	1:30 PM	2:00 PM
THU09-02	Lifecycle Cost Analysis of Photobioreactor Followed by Secondary RO for Enhanced Water Recovery in Brackish Water Desalination	In this presentation, we will show the preliminary result of our lifecycle cost analysis (LCCA) of a new diatom photobioreactor-secondary reverse osmosis (RO) system for the treatment of brackish groundwater RO concentrate and enhanced water recovery. The data from our laboratory experiments are utilized to estimate the water recovery, constituent uptake and removal, chemical usages, byproduct production, and energy demand to construct the LCCA model. Several possible scenarios such as variable light sources (sunlight vs. light emitting diodes) and energy sources (conventional vs. renewable sources) will be evaluated to discuss the economic feasibility of this novel green approach to enhance brackish water desalination.	2/24/2022	2:00 PM	2:30 PM

THU09-03	A Plethora of Seawater Intakes: Which will be Selected?	The Carlsbad Desalination Plant received the first permit approved by the Regional Water Quality Control Board under California's Ocean Plan Amendment. This presentation will cover the steps taken, seawater intake alternatives evaluated, and lessons learned along the path to obtain regulatory approval. This process can be a guide to other agencies considering ocean desalination for water reliability, self-reliance and sustainability goals as well as ideas for cost effective intake solutions.	2/24/2022	2:30 PM	3:00 PM
THU10	THU10 - Data Management		2/24/2022	1:30 PM	3:00 PM
THU11	THU11 - MBR - Part 3		2/24/2022	1:30 PM	3:00 PM
THU11-01	Footprint Matters. How a Compact, MBR Hybrid Ultrafiltration Membrane Can Save Space and Meet Strict Reuse Permeate Quality	This paper describes how a hybrid ultrafiltration immersed ultrafiltration membrane – FibrePlate™ – is able to filter mixed liquor in membrane bioreactor applications in half the footprint or less required by other immersed membranes. This paper presents design information and operating data and effluent quality results from 5 North American MBR plants, greenfield and retrofit plants. The MBR permeate samples were analyzed with a microbiological emphasis to show the capability of a tight ultrafilter to remove Protozoa, Bacteria and Viruses as required to meet the strict criteria for future DPR/IPR water reuse plants.	2/24/2022	1:30 PM	2:00 PM
THU11-02	Uniquely Innovative and Practical : Membrane Aerated Biofilm Reactor (MABR) for Nutrient Removal, Resiliency and Energy Efficiency	Membrane Aerated Biofilm Reactor (MABR) is an innovative approach to intensifying wastewater treatment by increasing capacity of existing plant for nutrients removal, providing process resiliency and minimizing aeration energy. MABR provides higher nitrification rates and oxygen transfer efficiencies as compared to conventional activated sludge and other biofilm technologies such as IFAS/MBBR. MABR zone can be operated as anoxic reactor, achieving simultaneous nitrification-denitrification. This paper presents MABR performance data from full-scale as well as pilot-scale plants.	2/24/2022	2:00 PM	2:30 PM
THU11-03	Role of Membrane Fouling Layer on Release of Antibiotic Resistance Genes from Anaerobic Membrane Bioreactor	We evaluated the role of membrane fouling layer in release of intracellular and extracellular ARGs (iARGs and eARGs) from a bench-scale AnMBR. For this purpose, we operated the AnMBR for a duration of 6 month. Molecular biology methods (cloning, qPCR) were employed to analyze the presence of iARGs and eARGs. Results showed that membrane fouling inversely impacts iARGs and eARGs abundances in the effluent of AnMBR.	2/24/2022	2:30 PM	3:00 PM
THU12	THU12 - Industrial Applications - Part 2		2/24/2022	1:30 PM	3:00 PM

THU12-01	Enhanced Membrane Distillation With In-Situ Conductive Heat Delivery for High Salinity Oil and Gas Wastewater Treatment	Membrane distillation (MD) is an emerging thermal desalination technology capable of treating high-salinity oil and gas wastewater. During standard MD processes, the water itself acts as the thermal energy carrier, which leads to thermal polarization, low single-pass recovery rates, and poor thermal efficiency. An alternative approach is to use thermal energy carriers through the use of composite membrane materials that incorporate these energy carriers and funnel externally provided heat to the membrane/water interface or into the feed channel itself. This direct heat delivery has been demonstrated to increase the potential for single-pass water recovery, as well as enhance the thermal efficiency of the MD process.	2/24/2022	1:30 PM	2:00 PM
THU12-02	Comparison of Power Generation Between Pressure Retarded Osmosis and Reverse Electrodialysis	By the passage of time, population growth, the water demand and, the energy consumption has been increased and encouraged the explorations, of alternative of water and energy resources. Developing osmotic processes which are driven by membrane may supply sustainable solutions for the needs globally of either clean water or the clean energy. Osmotic processes use the difference of osmotic pressure solutions through a semipermeable membrane for drawing water from a diluted feed solution to a draw solution that is more concentrated.	2/24/2022	2:00 PM	2:30 PM
THU12-03	In-Situ Heat-Enhanced Membrane Distillation for Hypersaline Oil and Gas Wastewater Treatment	Desalination by MD is still considered energy-intensive, therefore, minimizing the energy consumption and integrating renewable energy as the heat source are important for MD to become more practical and economically viable. We report on an MD process that incorporated materials with varying thermal conductivity values into the membrane and flow channel, with thermal energy conducted directly to the membrane/water interface and/or the inside of the flow channel. This process can potentially provide a solution to desalinating highly concentrated brines at a lower cost.	2/24/2022	2:30 PM	3:00 PM
TUE01	TUE01- High Recovery/ZLD - Part 1		2/22/2022	10:30 AM	12:00 PM
TUE01-01	Innovative Use of Engine Exhaust to Treat Reverse Osmosis Concentrate	In 2018 Energy Power Partners (EPP) identified an opportunity to use previously wasted heat from its existing Energy Plant to evaporate landfill leachate from an existing reverse osmosis ("RO") system using the LM-HT® Concentrator from Heartland Water Technology. Prior to the project, the solid waste complex was hauling 25 trucks per week of highly concentrated liquid for disposal. By evaporating RO Concentrate on-site, EPP significantly improved efficiency, reduced operating costs and delivered a more environmentally sustainable solution. In the presentation members of the project team will discuss efficiency improvements, RO Concentrate volume reduction and the economic and environmental benefits of on-site treatment.	2/22/2022	10:30 AM	11:00 AM

TUE01-02	High-Pressure Reverse Osmosis System Treating Wastewater From a Pharmaceutical Production Facility as Part of a ZLD Project	A new pharmaceutical assay production facility required a ZLD wastewater facility due to local regulations. The ZLD system included a 1,300 psi spacer tube reverse osmosis (STRO) system as pre-treatment for the evaporation. Due to feed complexity, which exhibited elevated TDS, organics and scaling potential, as well as high water recovery of 95%, the design required pilot testing be performed at an existing sister facility in the United States. The pilot trial ran for a period of 10-weeks, seven days a week, 24 hours per day. The trial showed that 95% recovery was achievable with 5.6GFD flux, with pH control and antiscalant dose as pre-treatment. The results of the trial will be shared and discussed, as well as commercial design details	2/22/2022	11:00 AM	11:30 AM
TUE01-03	Brine Minimization Maximizes Potential for Inland Potable Reuse Project	Rancho California Water District (Rancho Water) in Temecula, California has been studying options for a groundwater injection indirect potable reuse (IPR) project to provide a locally controlled, drought-resistant supply that decreases salt loading to the groundwater basin. The largest hurdle to project implementation for this inland water agency is the disposal of reverse osmosis (RO) concentrate. This project used economic and non-economic criteria to demonstrate how Rancho Water could use high recovery RO and brine ponds with an enhanced evaporation technology to implement a larger IPR project than originally anticipated to improve water supply resiliency without access to a brine line or ocean outfall for RO concentrate disposal.	2/22/2022	11:30 AM	12:00 PM
TUE02	TUE02 - New Plant Construction and Retrofits		2/22/2022	10:30 AM	12:00 PM
TUE02-01	Maximizing Membrane Treatment in an Existing Facility with Prescriptive Upgrades	An example of how planning and innovation pays off. This presentation will review how the Upper Trinity Regional Water District was able to squeeze an additional 10 MGD out of an existing Membrane Water Treatment Plant to meet record demands.	2/22/2022	10:30 AM	11:00 AM
TUE02-02	Construction and Startup of a 7-Stage RO System at the Valencia Advanced Water Treatment Facility	This paper presents an update on the construction process and startup of an innovative treatment process that includes MF, NF, ion exchange, CO2 removal, and 7-stage RO to remove chlorides from tertiary treated wastewater. The finished water is blended with wastewater to meet updated chloride requirements in plant effluent. The RO process is performed at high pH to keep silica in solution in order to achieve 99.2% recovery. Construction started in May 2019 and commissioning activities will start in late 2021.	2/22/2022	11:00 AM	11:30 AM

TUE02-03	Creating a Soft Spot in Your Water - Turning an Aging Lime Softening Water System into a State of the Art Membrane MF/NF Plant	Approaching 40 years in service, this 300,000 gpd, aging water treatment plant needed major upgrades. Located in West Virginia, the existing treatment process consisted of an up-flow lime softening system for hardness, dual media filtration, packed tower aeration, GAC absorption, and disinfection. Source water for the plant provided by three wells is classified as groundwater under the influence of surface water and included the presence of volatile organic compounds and radon contaminants. The treatment process was replaced by an integrated MF/NF system and the project included pilot testing of the integrated process. The system was commissioned in September 2021.	2/22/2022	11:30 AM	12:00 PM
TUE03	TUE03 - Potable Reuse Applications - Part 1		2/22/2022	10:30 AM	12:00 PM
TUE03-01	The Headworks DPR Demonstration Project: Implementing DPR for the City of LA	LADWP is developing a DPR Demonstration Facility at their Headworks Reservoir site to evaluate alternative treatment trains, support regulatory developments and garner public support for future potable reuse programs. This presentation provides an overview of the project and the proposed testing plan.	2/22/2022	10:30 AM	11:00 AM
TUE03-02	IPR vs DPR: Which One Makes More Sense For Your Community	Direct potable reuse is now being considered a feasible opportunity and has the attention of many Arizona communities as being a potential long term solution for sustainably mitigating the risk of water shortage for future generations. This presentation will provide the audience insight regarding common ground for IPR and DPR, explore the major differences between the two, address the pros and cons when comparing IPR and DPR, discuss different types of water reuse strategies and how they can be developed, and address what are the challenges and how to make potable reuse projects successful based on several decades of research and practical experience gained from California experience.	2/22/2022	11:00 AM	11:30 AM
TUE03-03	Artificial Intelligence and Machine Learning in Potable Reuse Projects	The aim of this paper is to demonstrate that artificial intelligence (AI) and machine learning (ML) can be successfully applied in potable reuse projects. To do that, the artificial neuron networks (ANN) were developed using pilot and full-scale data from two different potable reuse trains. Despite substantial changes in feed water quality and other operational parameters, the ANN models have successfully predicted (R2 ranged between 0.891 and 0.992) RO permeate TOC quality for compliance and power consumption and third stage specific fluxes of RO trains for plant optimization. This study clearly showed that AI/ML is a powerful tool to support our decision in potable reuse while reducing errors and boosting confidence.	2/22/2022	11:30 AM	12:00 PM
TUE04	TUE04 - Membrane Filtration - Part 1		2/22/2022	10:30 AM	12:00 PM

TUE04-01	An Emerging Application for Low-Pressure Membranes: Treatment of Backwash Waste at Surface Water Treatment Plants for Potable Use	In this study, UF membrane treatment with polymeric and ceramic membranes will be compared while treating media filter backwash waste from a full-scale drinking water treatment plant. Treatment using UF membranes will potentially enable direct blending of filtrate with finished potable water and reduce challenges associated with recycling backwash water, minimize solids loading on sludge handling facilities and reduce overall operational costs.	2/22/2022	10:30 AM	11:00 AM
TUE04-02	Optimizing Organics Removal from Surface Water in a Coagulation / Ultrafiltration system: 3 Years Operating Experience	This paper describes three and a half years of operating experience of a full scale UF system. The system uses a unique feed forward control loop for coagulant dosing: feed UV absorption and target filtrate quality are being used to optimize the coagulant dose. After three years of operation two membrane modules (one from the primary UF system and one from the secondary UF system) have been removed for autopsy and investigation. Operational data and results of the investigation confirm the success of the coagulant dosing strategy.	2/22/2022	11:00 AM	11:30 AM
TUE04-03	The Case for Ultrafiltration Membranes to Enhance GAC and BAC Performance	Ultrafiltration membranes are known for providing a high quality effluent with near zero turbidity and pathogens. However, the positive impact of upstream ultrafiltration membranes on GAC performance is not well known. The GAC performance data of 3 plants - 2 in Canada and 1 in Italy demonstrate the remarkable ability of UF to increase the time between backwashes, reactivation and replacement of GAC media. Furthermore, biological activity appears to be enhanced when fed by water filtered by UF membranes.	2/22/2022	11:30 AM	12:00 PM
TUE05	TUE05 - High Recovery/ZLD - Part 2		2/22/2022	1:30 PM	3:00 PM
TUE05-01	Freezing vs. Evaporation for Zero Liquid Discharge Desalination	Several new technologies have been under development in recent years to achieve Minimum or Zero Liquid Discharge (MLD/ZLD). The technologies vary widely with respect to processes used, water quality limitations, utility requirements, footprint, cost, etc. This paper will discuss two processes that take completely different approach – thermal processes vs. eutectic freezing. Results of a bench scale testing done to treat highly saline wastewater will be presented, including relative costs.	2/22/2022	1:30 PM	2:00 PM

TUE05-02	The Evolution of High Recovery Reverse Osmosis To Achieve 95%+ Recovery	Increasing regulatory requirements and disposal costs, as well as ESG mandates and incentives for recycle around the world are prompting industries to reduce their water and energy footprint, and highlight a growing need for innovation in reverse osmosis technology. This paper describes the evolution of HERO (high efficiency reverse osmosis) as well as developments to achieve recoveries greater than 95% for ZLD and MLD applications. It will also cover some industrial applications where very high recoveries continue to be achieved, and the continuous progress the water industry is making in ZLD/MLD applications to achieve water recycle and sustainability goals.	2/22/2022	2:00 PM	2:30 PM
TUE05-03	Designing with Turbochargers: Case Studies for Ultra High Pressure RO Operation	The presentation will contain state-of-the-art information regarding RO design in UHP application. This work focuses in the UHP RO ZLD plant located at the Turow power plant in Bogatynia, Poland, arguably the first UHP RO plant in the European continent.	2/22/2022	2:30 PM	3:00 PM
TUE06	TUE06 - O&M - Part 1		2/22/2022	1:30 PM	3:00 PM
TUE06-01	Thirteen Years of Operation of the World's Largest Zero Liquid Discharge Membrane Plant – What Works and What Doesn't	The 100-mgd Twin Oaks Valley WTP, a ZLD facility utilizing submerged ultrafiltration has been in operation for 13 years. This paper will describe the modifications that have evaluated and implemented from plant start-up through present to improve operation with focus on control of membrane fouling.	2/22/2022	1:30 PM	2:00 PM
TUE06-02	"Just Three More Years": Creating a Membrane Plant Evaluation for Elevated Production and Risk	The Quinn's Junction Water Treatment Plant in Park City, Utah recently underwent upgrades to be able to produce more water at a critical time in the towns history. The presentation will relate what those upgrades were and how they were accomplished.	2/22/2022	2:00 PM	2:30 PM
TUE06-03	Magnetic Fields and Manipulation of Water Behaviors: A Viable Method for Reducing RO Specific Energy Consumption	Increasing the specific water flux through salt rejecting membranes, while maintaining ion selectivity, is the overriding goal of many in the membrane community. Our efforts have centered on manipulating the properties of water, rather than those of the membrane, using magnetic fields to achieve this goal. The technology to be discussed in this presentation relies on the energy introduced into water as it passes through a series of magnets arranged in a pipe to create an aligned magnetic field. Increases of specific water flux for downstream NF and RO membranes >40% have been observed. This presentation will cover the theory behind this phenomenon and the performance results (flux, specific energy consumption, ion rejection, fouling) we hav	2/22/2022	2:30 PM	3:00 PM
TUE07	TUE07 - Potable Reuse Applications - Part 2		2/22/2022	1:30 PM	3:00 PM

TUE07-01	Potable Reuse Program Operation and Management	This presentation will provide awareness and detailed interpretation of the the new combined AWWA G485-20 Standard for the Potable Reuse Program Operation and Management. This new standard is just recently approved and as Chair of the AWWA Standard's committee responsible for the development of this standard I would like to introduce this standard to the water professionals and provide any additional information regarding this new standard.	2/22/2022	1:30 PM	2:00 PM
TUE07-02	Design Criteria and Operating Conditions have Sizeable Impacts on Trace Organic Removal by Reverse Osmosis for Potable Reuse	This presentation describes the results of mathematical modeling that demonstrates the extent to which reverse osmosis design criteria and operating conditions affect the removal of trace organics in potable reuse applications. Reverse osmosis is used in advanced treatment facilities to remove a wide variety of organic compounds, and achieving high removal is important for protecting public health. Two important outcomes of this study are (1) the rejection of neutral organics is much more sensitive to design and operating conditions than is the rejection of ionic species and TDS, and (2) the objective to maximize organic rejection is potentially in direct conflict with objectives to maximize water recovery and minimize energy consumption.	2/22/2022	2:00 PM	2:30 PM
TUE07-03	Innovation in the Face of Necessity: When Potable Reuse Becomes the Only Option	As Florida utilities max-out their groundwater permits and reclaimed reuse for irrigation, they are looking beyond traditional strategies and tapping into potable reuse as a double-down solution. Although various pilot studies throughout the country have demonstrated the technical feasibility of potable reuse, the framework for implementation is a work in progress. Public perception and acceptance remain major obstacles. But Florida can learn from the journey of Texas, a state forced into direct potable reuse by necessity. The presentation will discuss how recent Florida regulations are highlighting the challenge and opportunity of implementing potable reuse; and present lessons learned from implementation of potable reuse in Texas.	2/22/2022	2:30 PM	3:00 PM
TUE08	TUE08 - Membrane Filtration - Part 2		2/22/2022	1:30 PM	3:00 PM
TUE08-01	No-Break Fiber Solves Membrane Integrity Problems at Five Water Treatment Plants	What do Byesville, OH, Two Rivers, WI, Butler, MO, Garden City, MO, and Amsterdam, MO have in common? They all have drinking water plants that were on the verge of crisis due to fiber breakage in their low-pressure membrane systems. That is, until they took a chance on a membrane that had been used extensively in drinking water plants worldwide but seldom in the United States. This presentation describes how each of these plants were able to get swift state approval to replace their membranes with modules containing unique honeycomb-like fibers, and how the plants have performed since then.	2/22/2022	1:30 PM	2:00 PM

TUE08-02	Evaluating and Improving Energy Efficiency at MF/UF Membrane Filtration Facilities	Energy use at membrane filtration facilities should be a key criterion in the design. There are enough facilities operating now to gather statistics and make a broad comparison. The AWWA Membrane Processes and Research Committee surveyed facilities and analyzed data to share best practices and energy-reduction ideas with the field.	2/22/2022	2:00 PM	2:30 PM
TUE08-03	Implementation of Passive Membrane Filtration for Potable Water Treatment	Gravity Driven Membrane Filtration with passive fouling control measures, hereafter referred to as Passive Membrane Filtration (PMF), was recently implemented to provide potable water for a small First Nation Community on Vancouver Island. Because of its simplicity, PMF is ideally suited for use in small and/or remote communities. The presentation will introduce the key outcomes from recent laboratory and pilot-scale investigations, describe how these were incorporated into the design of the full-scale PMF system for the community, summarize performance results at full-scale for the first 16-months of operation, and describe the simple operational requirements for the successful operation of PMF for potable water treatment.	2/22/2022	2:30 PM	3:00 PM
TUE09	TUE09 - Pretreatment		2/22/2022	3:45 PM	5:15 PM
TUE09-01	Introducing AMTA's New Universal Specialty Chemical Compatibility Guideline for Spiral Membranes	Virtually all RO/NF systems operate in concert with specialty chemicals designed to protect the membranes from scaling and fouling as well as clean the membranes. It is vital that these specialty chemicals be compatible with the membranes. There has been an ongoing, multi-year process to develop a uniform compatibility test guideline for new specialty chemicals. This paper will introduce the main aspects of the new specialty chemical compatibility guideline to the industry, including the roles of each participant, the process of testing, the witnessing and verification of statistical models, and the preparation of documentation that compatibility has been verified.	2/22/2022	3:45 PM	4:15 PM
TUE09-02	Pre-treatment and Nanofiltration Pilot Study to Manage Increased Particulate Loading and Reduced Acid Feed Conditions	The City of Boynton Beach owns and operates the West WTP located in Southeast Florida. The West WTP treats water from the surficial aquifer with high TOC, alkalinity, hardness and modest concentrations of iron and hydrogen sulfide. This paper presents results from a 6-month pilot study. The objectives were: (1) to investigate effective pre-treatment alternatives including granular media filter and sand strainer, for solids removal (2) to evaluate scale inhibitors to meet the City's acid reduction/elimination goal and (3) to test several membrane combinations to meet the City's finished water quality goals. The presentation will present the results of the different pilot study phases and recommendations for implementation.	2/22/2022	4:15 PM	4:45 PM

TUE09-03	The Perils of Using Chloramines for Pretreatment of Water Reuse RO	The use of chloramines has become a standard pretreatment method for biofouling control in water reuse RO. When used in the 2 - 3 ppm range, chloramines have been known to cause only minimal losses in salt rejection, and the benefits are generally believed to far outweigh the risks. However, in recent years, significant irreversible declines in permeability have been observed at some plants, with no foulants found on the membrane surface or incoming feed water. At one plant using membranes from 3 different manufacturers, trains containing certain models saw an irreversible permeability loss of >50% while other trains continued to operate normally. Analysis verified that chloramines were chemically altering the membrane properties.	2/22/2022	4:45 PM	5:15 PM
TUE10	TUE10 - Treatment Process Selection - Part 1		2/22/2022	3:45 PM	5:15 PM
TUE10-01	Evaluating Inhibitors for Infrastructure Corrosion Control for a Blended Reverse Osmosis and Ion Exchange Process Water	The U.S. Environmental Protection Agency's Lead and Copper Rule Revisions, which take effect on December 16, 2021, has motivated utilities to study their finished water's corrosivity. The City of Sarasota Utilities Department (City) retained the University of Central Florida (UCF) to study the existing corrosion conditions and how planned future changes to their treatment process may affect corrosion rates. Corrosion test rack loops were monitored by UCF at the City's WTP, testing several blended-phosphate inhibitors and their effect on the corrosion rates of different metal alloys. To study how alternative membrane treatments may affect the corrosion rates, UCF designed a flow-through update to a typical bench-scale metal coupon jar test.	2/22/2022	3:45 PM	4:15 PM
TUE10-02	Delivering a Sustainable Water Supply through Membrane Technologies	This paper describes how the City of Santa Monica leveraged various membrane technologies, including MBR, NF, RO, and high recovery reverse osmosis to develop a sustainable water supply and meet over 90% of its water demand through local supplies. The City's sustainable water supply includes: 1) a brackish groundwater desalter that will be upgraded with Flow Reversal RO to achieve 90% recovery, 2) an underground potable reuse facility that uses MBR and RO to produce purified water for groundwater augmentation, 3) an urban runoff/stormwater treatment facility that will use RO for directly inject the treated water for groundwater recharge, and 4) an on-site NF treatment facility to support a self-sustaining Living Building.	2/22/2022	4:15 PM	4:45 PM
TUE11	TUE11 - Wastewater Applications		2/22/2022	3:45 PM	5:15 PM

TUE11-01	Use of Advanced Three-Stage Membrane System for Turning Extreme Wastewater into Boiler Feed Water	Reuse of industrial wastewater is integral to corporate social responsibility planning. Reuse of challenging wastewaters can present operational challenges. This paper reports the design and operational experiences from a three-stage wastewater reuse system comprising crossflow ceramic UF pre-treatment; followed by ceramic MBR; and a spacer tube reverse osmosis (STRO) system for achieving 90% reuse. The UF and MBR came online in 2019 and the STRO 18 months ago. Typical wastewater comprises COD > 45,000 mg/l, oil and grease over 1,500 mg/l, and TSS over 1,000 mg/l and the wastewater is reused for boiler feed water and cooling tower makeup	2/22/2022	3:45 PM	4:15 PM
TUE11-02	How Improving Performance and Packing Density Can Be Achieved Concurrently with a Flat-Sheet MBR	<p>Membrane manufacturers continue to improve on the MBR module design to provide end-users with lower capital costs, ease of maintenance and lower operating costs over the life, which is typically 10 years.</p> <p>One membrane manufacturer introduced the TMR series flat-plate MBR module in 2003 and 13 years later introduced the higher surface area NHP series flat-sheet MBR module in 2016. While the same membrane is used in both the TMR and NHP modules, the evolution from Plate to Sheet resulted in 50% higher surface area, reduced fouling, and reduced weight for ease of shipping and handling.</p> <p>This paper will discuss side-by-side testing of the Plate TMR module versus the NHP series Sheet module.</p>	2/22/2022	4:15 PM	4:45 PM
TUE11-03	Implementation of an Integrated Membrane System to Expand Reuse - City of Phoenix Cave Creek Water Reclamation Plant	The Cave Creek Water Reclamation Plant (CCWRP) is one of three wastewater treatment facilities either owned or co-owned by the City of Phoenix (City). The 8 mgd facility was placed in operation in 2002 but was taken offline in 2009 due to slower than anticipated growth in the surrounding area. Due to resumed growth, the City authorized Black & Veatch (B&V) to conduct a Phase I Feasibility Study (completed in 2017) to identify any existing design limitations and evaluate alternatives to improve overall process performance and reduce operational costs. Phase II CCWRP improvements include the design/equipment procurement of membrane systems (MBR and RO) to expand the plants reuse production capacity and improve reclaimed water quality.	2/22/2022	4:45 PM	5:15 PM
TUE12	TUE12 - Treatment Process Selection - Part 2		2/22/2022	3:45 PM	5:15 PM

TUE12-01	Which Membrane to Choose? A Comparison of Ceramic, PVDF, and PES Ultrafiltration Membranes for Surface Water Treatment	This paper will describe a 2-year pilot study testing ceramic, PVDF, and PES ultrafiltration membranes for surface water treatment, with and without pretreatment. Flux rates ranged from 40 – 200 gfd, with recovery ranges from 93 – 98%. Energy consumption was evaluated at various flux rates and a capital and operating cost comparison was developed for the 4.8 MGD full-scale plant. UF will ultimately replace an existing media filtration system and provide greater capacity in the same footprint. Owners and engineers will find this information relevant for comparing membrane module options, pretreatment considerations, retrofitting media filtration equipment, and pilot study optimization in preparation for full-scale equipment design.	2/22/2022	3:45 PM	4:15 PM
TUE12-03	A Dual Source Water Treatment Facility Evaluates the Expansion of a GWRO Plant and the Inclusion of Membranes in their SWTP	The City of Melbourne blends treated water from a ground and surface water treatment facility to provide potable water to their clients. Portions of the facility are over 40 years old and there are process and equipment issues that limit the capacity of the plant. The City wants to optimize the use and treatment of their available and future source water to increase production capacity, provide added resiliency and robustness, and reduce whole life costs. The primary focus of this paper will be a discussion of balancing the two available source waters and the cost to improve, repair or modify each treatment plant, the process alternatives evaluated and pros and cons of inclusion of membranes in the surface water treatment plant.	2/22/2022	4:45 PM	5:15 PM
WED01	WED01 - NF/RO - Part 1		2/23/2022	8:15 AM	9:45 AM
WED01-01	Reversing the Flow – Full-Scale Design Considerations for Flow Reversal Reverse Osmosis	This paper describes the results of pilot testing Flow Reversal Reverse Osmosis (FRRO) technology in an existing brackish groundwater treatment plant to increase membrane system recovery to at 90 percent or greater and help the City of Santa Monica achieve its water sustainability goals. The City has limited additional local water supplies available and is seeking the most cost-effective and sustainable technology capable of squeezing as much production as possible from the existing Arcadia Water Treatment Plant. Pilot testing results informed the City’s risk assessment of high-recovery reverse osmosis, full-scale design including retrofit versus new skids, and construction implementation strategies.	2/23/2022	8:15 AM	8:45 AM

WED01-02	The First U.S. Installation of a BWRO Pressure Exchanger	Energy recovery technologies such as the pressure exchanger (PX), have previously focused on seawater RO applications due to the rather quick payback. This leaves brackish water RO (BWRO) facilities to pelton wheel recovery turbos that yield less efficient transfer of energy than their PX counterparts. Recently, the first municipal BRWO application of a PX energy recovery device was designed for the City of North Port's Southwest Water Treatment Plant and will be started up in late 2021.	2/23/2022	8:45 AM	9:15 AM
WED01-03	NOM Removal and DBP Precursor Reduction Comparisons Between NF and RO Membranes for High Organics Source Waters	As part of the preliminary design, a bench scale treatability testing program was completed as means of comparing NF membranes and "low-pressure" RO membranes in terms of operating pressure, NOM removal, hardness reduction and DBP precursor reduction, along with several other operational and water quality characteristics, for a variety of NF/RO bypass scenarios, and blend ratios with the existing softening plant effluent. This testing also provided an opportunity to validate membrane projection information for the NF/RO membranes. Pilot data is also provided to validate the information obtained during the treatability testing.	2/23/2022	9:15 AM	9:45 AM
WED02	WED02 - Advancements in Membrane Materials		2/23/2022	8:15 AM	9:45 AM
WED02-01	Hollow Fiber Nanofiltration Processes for Wastewater Effluent Re-use: Tuning Membrane Properties to Lower Operational Cost	The presentation outlines the development of a novel hollow fiber nanofiltration (NF) membrane that offers an efficient treatment process versus conventional treatment technologies for the removal of organic micropollutants and total organic carbon (TOC) from wastewater effluent. The paper provides an overview on the ability to fine tune the conditions in membrane development process to present pH-stable hollow fiber NF membranes that can tolerate aggressive cleaning regimen with the use of strong oxidants. Molecular weight cut-off (MWCO) of these membranes determine if pure water can be produced in a single step or a permeate-polishing step is required to meet the drinking water standards.	2/23/2022	8:15 AM	8:45 AM

WED02-02	New Material Membranes and The Holy Grail: Chlorine Stable Reverse Osmosis Membranes	<p>The need for new material membranes for liquid separation operations has never been greater. The polyamide TFC membranes dominate the market and the limits of reverse osmosis membranes are universally accepted. NALA is developing new material membranes for reverse osmosis (RO) to break the paradigm of those membrane-imposed limits and reduce the cost and complexity of RO operations. NALA membranes are stable in the presence of free chlorine, demonstrate high rejection, and can operate under a wide range of pH, pressures, and temperatures. The presentation will benchmark NALA membrane performance against commercial RO membranes and discuss the opportunities for reducing both cost and complexity in RO operations.</p>	2/23/2022	8:45 AM	9:15 AM
WED02-03	Study of Safer Solvent Alternatives for Membrane Casting	<p>We will present our work studying safer solvents for PVDF membrane casting by the NIPS process. We review current regulatory restrictions and hazard ratings of common solvents such as NMP and DMAC and compare them to alternatives. We screened several alternate solvents for solubility of PVDF resin and solution stability. We carried out formulation and membrane casting work with DMSO and TEP solvents and compared membranes made with these solvents to those made with NMP. We also tested VF2-HFP copolymer resins and found better solubility in these alternate solvents.</p>	2/23/2022	9:15 AM	9:45 AM
WED03	WED03 - Potable Reuse Log Removal Credits - Part 1		2/23/2022	8:15 AM	9:45 AM
WED03-01	Pilot Testing for Validation of Log Removal Credit for Reverse Osmosis and Nanofiltration Membranes	<p>Reverse osmosis (RO) and nanofiltration (NF) are widely applied and trusted membrane treatment technologies for water and wastewater treatment due to their ability to effectively remove dissolved compounds, bacteria, and viruses. As potable water reuse expands in application, RO and NF are effective processes to achieve the safe, potable water. However, RO is given a log removal value (LRV) credit of 0.5–2 if any at all, even though research has proven RO to achieve LRVs of up to 4 for viruses. Therefore, this project tested different molecular markers such as a viral surrogate, a fluorescent dye, and native wastewater compounds to demonstrate the LRVs that RO and NF can achieve to help close the LRV discrepancy gap.</p>	2/23/2022	8:15 AM	8:45 AM

WED03-02	Full-Scale RO 3+ Log Removal of Virus Surrogates Using Native and Spiked Molecular Markers and Conductivity Profiling	As part of a Water Research Foundation project (No. 4958) led by Carollo Engineers, Orange County Water District (OCWD) is conducting a study on a full scale 5-MGD reverse osmosis (RO) unit to measure RO integrity using marker-based and conductivity profiling. The goal of the overall study is to develop methods to demonstrate virus surrogate removal during nanofiltration (NF) and RO treatment to obtain log removal value (LRV) credit. OCWD testing included electrical conductivity profiling, spiking of uranine with uranine profiling, and stage and train monitoring of sulfate and strontium (native ions).	2/23/2022	8:45 AM	9:15 AM
WED03-03	Demonstrating Greater LRVs across NF and RO Membranes Results from Two Full Scale RO-based Potable Reuse Treatment Facilities	Water Research Foundation Project RFP-4958 is conducting full and pilot scale RO testing with a goal to identify methods to demonstrate virus surrogates to obtain log removal value (LRV) credit using marker-based and conductivity profiling- based approaches. This presentation will focus on results from the Yucaipa Valley Water District (California) and the Water Corporation of Western Australia, which have performed approximately 6-12 months of full-scale RO testing of conductivity profiling, uranine profiling, and native ions (sulfate, magnesium, phosphate, and strontium). The testing results from this study lay the foundation for a framework that bridges the gap between drinking water and potable reuse pathogen regulations.	2/23/2022	9:15 AM	9:45 AM
WED04	WED04 - How to Buy? Membrane and Membrane System Procurement Options	This panel discussion will review options for membrane element (module) and system procurement. This is an important element of membrane selection.	2/23/2022	8:15 AM	12:00 PM
WED04-01	Membrane Element Procurement - Perspectives of a Membrane Utility	Membrane Element Procurement - Perspectives of a Membrane Utility	2/23/2022	8:15 AM	8:45 AM
WED04-02	Membrane Element Procurement - Vendor Perspective	Membrane Element Procurement - Vendor Perspective	2/23/2022	8:45 AM	9:15 AM
WED04-03	Membrane Element Procurement - Utility Perspective	Membrane Element Procurement - Utility Perspective	2/23/2022	9:15 AM	9:45 AM
WED04-04	Networking Break		2/23/2022	9:45 AM	10:30 AM
WED04-05	Membrane System Vendor - Procurement Perspective	Membrane System Vendor - Procurement Perspective	2/23/2022	10:30 AM	11:00 AM
WED04-06	Panel Discussion		2/23/2022	11:00 AM	12:00 PM
WED05	WED05 - High Recovery/ZLD - Part 3		2/23/2022	10:30 AM	12:00 PM

WED05-01	High Recovery Desalination Technologies and Concentrate Management	Four years ago, at MTC17, I presented a paper entitled Overview of Efforts to Reduce High Recovery and Zero Liquid Discharge Costs. The coverage involved research and development of technologies targeted for both industrial and municipal applications. Since that time, considerable progress has been made in bringing new technologies and modifications of conventional technologies toward commercialization. The proposed paper reviews general approaches to reduce costs and the status of several technologies including promising areas of application.	2/23/2022	10:30 AM	11:00 AM
WED05-02	Residuals Management & Zero Liquid Discharge Using Ceramic Membrane DeWatering	Ceramic membrane De-Watering and Recovery does more than dewater for efficient residuals management. It recovers the water for reuse, creating true Zero Liquid Discharge and a chemical free solution. The heart of the process is a unique ceramic membrane technology which performs the separation, recovery and concentration of the fluid and solids. The solids can be organics, metals, silt or biomass in any combination from which the water is removed until the solids form a sludge. The elimination of drying beds, thickening tanks, screw presses, solids handling and polymer reduces cost, footprint, and complexity. Application data from full-scale ZLD plants will be presented.	2/23/2022	11:00 AM	11:30 AM
WED05-03	RO Membrane Compaction and Embossing at High and Ultra-High Pressure	Replacing energy-intensive thermal desalination with an ultra-high pressure reverse osmosis (UHPRO) process has the potential to reduce the energy consumption and cost of brine concentration by up to 50%. This study tested commercial membranes including BWRO, SWRO and HPRO performance under pressures up to 3000 psi, with the objective of investigating the feasibility and potential of using RO membranes to achieve M/ZLD.	2/23/2022	11:30 AM	12:00 PM
WED06	WED06 - PFAS - Part 1		2/23/2022	10:30 AM	12:00 PM
WED06-01	Closed-Circuit High-Pressure Membrane Systems for the Separation of Per and Polyfluoroalkyl Substances	In this study, five commercially available membranes (NF270, NF90, BW30, SW30, and CR100) spanning the NF and RO separation ranges were investigated for their PFAS rejection performance. The specific focus was devoted to evaluating the removal of perfluoroalkyl acids (PFAAs) in a full-scale CCRO pilot module operating at 97% recovery. The results of these membrane evaluations were compared based on overall PFAAs rejection and estimated specific energy consumption. In addition, another set of experimentations were conducted for the determination of the primary rejection mechanism of PFAAs by the NF270 membrane at higher recoveries as a function of pH, ion strength, and initial PFAS concentrations.	2/23/2022	10:30 AM	11:00 AM

WED06-02	A Tale of Two Pilots: PFAS Removal with Thin Film Nanocomposite Membranes	This presentation will review two case studies where low-energy brackish water reverse osmosis membranes were used for removal of PFAS and other polyfluorinated constituents of emerging concern from contaminated water supply.	2/23/2022	11:00 AM	11:30 AM
WED06-03	More is Better: Membranal Approach to Effective PFAS Removal at the Highest Recovery Rates of 97%	<p>Everyone knows that RO is a superior technology for removal of PFAS compounds from water, but what if we could combine excellent removal with the highest recovery possible?</p> <p>In this paper we will describe the results of a pilot treating UF pre-treated river water that contained various types of PFAS compounds with Flow-reversal RO technology, that employs conventional RO equipment with two unique and continuous process functions: Flow-Reversal and Block Rotation.</p> <p>We will explain how the technology works and present data highlighting the stable operation determined by documenting flows, flux, differential pressure, and more. While the conventional RO achieved a 90% - 93% recovery rate, the FR-RO operation resulted in effective removal of</p>	2/23/2022	11:30 AM	12:00 PM
WED07	WED07 - Potable Reuse Log Removal Credits - Part 2		2/23/2022	10:30 AM	12:00 PM
WED07-01	Verifying MBR Membrane Integrity with Pressure Decay Testing; Implications and Interpretation of Test Pressure	MBRs are the cornerstone of next-generation wastewater reuse systems for IPR/DPR; however, the lack of a recognized method for assigning LRV credits for MBRs is a regulatory drawback. While Tier 1 credits are currently recognized in CA, more stringent requirements will likely be required for reuse applications at the Tier 2 and 3 levels. Augmenting online turbidity measurements with a pressure decay test is a possible means forward. This presentation will discuss the implications of test pressure, and potential scenarios for low- and high-pressure PDTs. Additionally, a method for calculating an LRV based on defect size is presented along with data from advanced MBR facilities.	2/23/2022	10:30 AM	11:00 AM
WED07-02	Quantifying the Mechanisms Contributing to Pathogen Removal in Membrane Bioreactors	The purpose of this study is to further understand virus removal mechanisms prior to the membrane in membrane bioreactors (MBR). This presentation will quantify the mechanisms that contribute to virus removal in MBRs; that is, sludge adsorption and biofilm exclusion. Single strain, lab grown, male specific and somatic coliphages, with defined properties, were used to determine removal of human viruses for each of the mechanisms. While sludge adsorption plays a significant role in coliphage removal, the biofilm provides an added layer of exclusion that cannot be under struck. The findings of this study will be of interest to practitioners applying MBR for water reuse.	2/23/2022	11:00 AM	11:30 AM
WED07-03	Reverse Osmosis Regulatory Compliance Using Normalized Data	Securing additional log removal credits using the ASTM normalization equations for regulatory compliance	2/23/2022	11:30 AM	12:00 PM

WED08	WED08 - High Recovery/ZLD - Part 4		2/23/2022	1:30 PM	3:00 PM
WED08-01	High Recovery Water Reuse: An Innovative Method of Using Closed Circuit Reverse Osmosis (CCRO) – Pilot Study	This study investigated the feasibility of running high recovery water reuse membrane process and evaluated the removal efficiency of various solutes under different operating conditions and recovery rates.	2/23/2022	1:30 PM	2:00 PM
WED08-02	Design Considerations and Economics of Emerging Membrane Brine Concentration Processes	This paper addresses important design considerations for emerging membrane brine concentration processes including osmotically assisted reverse osmosis (RO) and ultra-high pressure RO. These processes are assessed on the basis of total cost of water over a range of final brine concentrations. For example, anticipated performance from modeled systems, validated with field testing, indicates that seawater brine can be desalinated at 50% recovery for as little as \$2.30/kgal or \$0.60/m3. The prospect of low costs combined with the broad market acceptance of membrane desalination methods portend a shift away from thermal brine concentration while opening new opportunities for the application of membrane technologies.	2/23/2022	2:00 PM	2:30 PM
WED09	WED09 - PFAS - Part 2		2/23/2022	1:30 PM	3:00 PM
WED09-01	Pilot Studies of Per-and Polyfluoroalkyl Substances (PFAs) Removal From Drinking Water with Membranes and Treatment of Membrane Concentrate	This presentation focuses on a pilot study currently underway for the treatment of per- and polyfluoroalkyl substances (PFAS) in membrane concentrate. The pilot study includes an evaluation of several traditional and non-traditional processes in parallel. The presentation provides a review of pilot set up, the test plan, and results obtained to date.	2/23/2022	1:30 PM	2:00 PM
WED09-02	Managing and Treating PFAS in Membrane Concentrates	This presentation reviews a list of possible options for dealing with PFAS in RO and NF concentrate streams. The various technologies were ranked by a 16-member committee as to their effectiveness and technology readiness.	2/23/2022	2:00 PM	2:30 PM
WED09-03	How Good Membrane are for PFAS Removal and Concentrate Management Practices	Selecting membrane options among other PFAS removal technologies requires understanding and integrating: Treatment objectives, Source water characteristics, Treatment scenario (e.g., facility size, retrofit limitations, existing unit processes, etc.), Secondary impacts (e.g., operational feasibility, waste stream disposal, etc.), and Fiscal constraints for capital and operating expenses. This presentation will discuss how the reject stream containing PFAS should be properly disposed based on few recent case studies: New Hannover County (NC), Brunswick County. RO Concentrate management practices and current PFAS destroying research will be part of this presentation.	2/23/2022	2:30 PM	3:00 PM
WED10	WED10 - Wastewater Fouling		2/23/2022	1:30 PM	3:00 PM

WED10-01	Statistical Analysis of Foulant Composition From Membranes Collected From Reuse Applications	This paper will review foulant collected from 50 membrane autopsies performed by PWT Chemicals and Genesys Membrane Products on re-use application membranes. A statistical breakdown of the foulant will be provided to compare and analyze the composition, water quality, and system design. This paper will also feature a more in-depth look at some specific examples chosen for their representative content.	2/23/2022	1:30 PM	2:00 PM
WED10-02	Membrane Coupled With Ozone for Alleviation of Fouling and Enhancement of Flux for Water Reuse	Low-pressure ceramic membranes coupled with oxidants can help augment limited water supplies for water-stressed regions. Ceramic membranes provide multiple advantages over traditional polymeric membranes, such as the ability to withstand more aggressive backwashing and chemical cleaning. Like all membranes, membrane fouling is still a major obstacle that limits the performance of membrane filtration, and high concentration of organic compounds in the wastewater provides a unique challenge. Due to ceramic membranes' unique advantages of being able to withstand strong oxidants, maintaining a small amount of ozone residual on the ceramic membrane surface can significantly reduce membrane fouling and improve membrane filtration.	2/23/2022	2:00 PM	2:30 PM
WED11	WED11 - Membrane Filtration - Part 3		2/23/2022	1:30 PM	3:00 PM
WED11-01	Marine Corps Base Quantico Microfiltration/Ultrafiltration Demonstration Study	Marine Corps Base Quantico is planning the design of a new Mainside Water Treatment Plant to replace the existing, aging facility. In accordance with the Virginia Waterworks Regulations and the Virginia Department of Health, a demonstration study was conducted to validate the membrane technology. Two modules were direct piloted while a third module was investigated through the evaluation of full scale operating data from a nearby municipality. A data evaluation effort was chosen in lieu of direct piloting the third membrane to save on costs for the demonstration study. This presentation details the results of the demonstration study and a look into the potential to utilize full scale operating data in lieu of direct piloting.	2/23/2022	1:30 PM	2:00 PM

		<p>Over the last 5 years, a partnership between AECOM and Suez have been developing Membrane Gravity Filtration (MGF), a gravity-driven membrane filtration variant that serves as a direct replacement for granular media filtration. MGF is now in operation or design for 4 water treatment plants, including the 132 mgd Lorne Park WTP, and the 58 mgd Whitby WTP, which will be the first plant in the world to use stacked DAF-MGF where DAF clarification and MGF will be constructed within the same tank, resulting in an incredibly small process footprint.</p> <p>This paper will present recent advances in MGF, and will explore the applicability of MGF and DAF-MGF for both conventional drinking water treatment, and as seawater desalination pre-treatment.</p>			
WED11-02	The Ongoing Development of Membrane Gravity Filtration (MGF)		2/23/2022	2:00 PM	2:30 PM
WED11-03	Flux and Antifouling Performance of Bioinspired Liquid-Infused Membranes	This research was supported by AMTA/Reclamation Fellowships for Membrane Technology and by the National Science Foundation, CBET awards 1930610 and 1930710.	2/23/2022	2:30 PM	3:00 PM
WED12	WED12 - Concentrate Management		2/23/2022	3:45 PM	5:15 PM
WED12-01	Investigating CCRO's Potential to Reduce Concentrate Flows on a Future Inland Water Reuse Application	This presentation will present the findings from a 7-month MF-CCRO pilot study conducted at Eastern Municipal Water District's San Jacinto Valley Regional Water Reclamation Facility. The pilot investigated the potential for Dupont/Desalitech's closed circuit reverse osmosis (CCRO) technology to sustainably operate at recoveries which exceed those normally achieved by conventional RO approaches (typically 92 to 93%) when treating nitrified tertiary effluent with low fouling potential. CCRO demonstrated an ability to operate at recoveries as high as 94% while still providing 30 days between chemical CIP cleans, a typical industry benchmark for sustainable operation in a municipal application.	2/23/2022	3:45 PM	4:15 PM
WED12-02	Three Years of High Recovery RO Pilot Testing with Eastern Municipal Water District	Eastern Municipal Water District has invested years of research into increasing the recovery at their Brackish Water desalter campus in Menifee, California. This presentation will summarize three years of pilot testing with a closed circuit reverse osmosis system, the end result of which was stable performance above 90 percent recovery. Surpassing this recovery point reduces brine production by 60% and exceeded the operational and economic goals of the research. The results from testing are being used to established the conceptual design criteria for a potential future full scale facility. All of which will be presented.	2/23/2022	4:15 PM	4:45 PM

WED12-03	Improving Locally Sourced Drinking Water Supply Through RO Brine Minimization at an Existing Groundwater Purification Facility	<p>The City of Oceanside is looking to improve water production from the Mission Basin Groundwater Purification Facility (MBGFP) through construction of two new groundwater wells and implementation of brine minimization technology. These improvements will help meet Project objectives of:</p> <ul style="list-style-type: none"> -Increase MBGPF production by 881 acre-feet per year (AFY), with 431 AFY of that from brine minimization. -Reduce purchases of imported water -Improve drought-resistant local supply reliability -Reduce brine volume discharged to the Pacific Ocean <p>This presentation will provide a review of the design approach for the brine minimization aspect of this project in which a new third stage RO is being proposed to reclaim greater than 40% of the brine.</p>	2/23/2022	4:45 PM	5:15 PM
WED13	WED13 - Experts in the Round		2/23/2022	3:45 PM	5:15 PM
WED14	WED14 - O&M and Membrane Filtration		2/23/2022	3:45 PM	5:15 PM
WED14-01	Cold Climate Surface Water Membrane Water Treatment Plant Operation Considerations	<p>The City of Fargo, ND, owns and operates a 15 MGD membrane WTP that treats surface water that has high fouling potential: 8-16 mg/L organics, TDS up to 1,000 mg/L, and wide temperature swing 33-85 °F. The plant faces various challenges through seasons: pretreatment upsets (poor settling) and high operating pressures in winter and spring, severe organic/bio fouling, and rapid differential pressure (DP) rising in summer. This manuscript documents important investigations the plant performed to improve the operations to consistently produce high quality drinking and shares the successful experiences to reduce the fouling potential, a new UF membrane fiber repair approach, bio-fouling mitigating options, reversed permeate flush and CIP.</p>	2/23/2022	3:45 PM	4:15 PM
WED14-02	Evolution of New Jersey's Largest Membrane Facility – Operations and Upgrades to City of New Brunswick's Water Treatment Facility	<p>The City of New Brunswick owns the largest membrane plant in New Jersey. The plant treats surface water from two sources of supply: the Delaware and Raritan Canal and Lawrence Brook. The original plant was constructed in the 1916 and consisted of clarification followed by dual media filtration and in the 1930s pressure filters were added. In 2008, the City commissioned a new membrane system to replace the pressure filters which had reached the end of their useful life. In 2018 the City began planning for expansion of membrane facility in order to replace the gravity filters. This paper will discuss the significant aspects of the design and operational phases along with the improvements that have been made over the decade of operation.</p>	2/23/2022	4:15 PM	4:45 PM

WED14-03	O&M Summary and Lessons Learned of the Ceramic Membrane Process at the Hilldale Water District in Vicksburg, MS in 2014	<p>A rural area called Hilldale Water District (HWD) located outside Vicksburg MS was faced with declining aquifer, its sole source for water (Forest Hill Aquifer). HWD decided that the best option to ensure water resource sustainability was to drill a well into the much deeper Sparta Aquifer. This Sparta Aquifer, unlike the Forest Hill Aquifer, is both wide-spread and abundant. However, water from the Sparta Aquifer is very high in color (150 CU), contains large quantities of dissolved organic carbon (DOC) and is very warm due to the depth of the aquifer (103 degrees Fahrenheit). The high DOC creates TTHM issues. This paper will provide actual OPEX data with a review of the NPV and system performance data over its operational history.</p>	2/23/2022	4:45 PM	5:15 PM
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